THE FUNCTIONAL MORPHOLOGY OF ORNITHODOROS TICKS

TRANSLATION NO. 1379

June 1965

UNITED STATES ARMY
BIOLOGICAL LABORATORIES
FORT DETRICK, FREDERICK, MARYLAND

THE FUNCTIONAL MORPHOLOGY OF ORNITHODOROS TICKS

[Following is the translation of an article by Ye. N. Pavlovskiy, published in the Russian-language periodical Parazitologicheskiy Sbornik Zoologicheskogo Instituta Akademii Nauk SSSR (Parasitology Collection of the USSR Academy of Sciences Zoological Institute), XIX, 1960, pages 26-31. Translation performed by Sp/6 Charles T. Ostertag Jr.]

In ticks of the genus Ornithodoros the first pair of legs seem mainly for raking forward; the remaining three pairs of legs serve primarily for pushing the body forward. In this, the legs have to make a combined movement which is explained by some peculiarities in the structure of the chitinous skeleton, securely united with the chitinous coverings of the ventral side of the body of the coxa -- the basal segment with which the first moveable segment of the leg, designated the trochanter, is loosely attached.

The coxa has a truncated conical form, spreading outward or outward and forward. Its distal end has the short oval form of a window framed with hard chitin, which is directly connected with the articular membrane made of soft chitin. This membrane is inseparably connected with the proximal basal annulus of the trochanter. Close to the base of it in the articular membrane there are three irregularly shaped islets of hard chitin adjacent to each other. From within, three muscle bundles are connected with these (figures 1 and 2). During their constriction they extend these islets inwards. The pressure of the hemolymph, which develops during leg movements, acts as the antagonist of the muscles. The annular edges of the coxa and trochanter come in contact with each other in two opposite points where each annulus carries a hard chitinous spur; both spurs of each point can move alongside each other under the influence of the contraction of internal muscles. Thanks to this the joint articulation of the coxa and trochanter is swinging, therefore the trochanter can move into two opposite sides in regard to the line between the system of articular spurs. As regards the hard chitinous islets in the soft articular membrane, they apparently are false moderators during the extreme inclination of the trochanter in the corresponding side.

The trochanter has the form of a short cylinder with one arched side which is longer than the opposite side. The proximal end of the trochanter is thicker and bears two hard spurs which were mentioned above.

The distal end of the trochanter is narrower than its base. And here there is a soft articular membrane connecting the trochanter with the next short segment of the leg.

The annular distal part of the trochanter has two hard conical spurs lying in a plane crossing with the plane of the spurs on the proximal ring of this same segment of the spurs on the coxa. Two muscles are attached to the distal thickened ring of the intercalary segment. When they are contracted, they depress it (and consequently the whole leg) on the sides opposite to the swing of the trochanter itself. In mechanism, a universal joint is the analog of these two pair of swinging joints.

The joints of the remaining segments of the legs are flexing and straightening; they cannot perform other movements.

Due to the combined work of the two pairs of swinging joints -- the trochanter with the coxa and the trochanter with the intercalary segment -- the leg is carried forward and pushed backwards. With the consecutive working of all the legs, this ensures the movement of the tick. Rotary movement is not attributed to the swinging joints.

II

A characteristic of a number of species of Ornithodoros ticks is the presence, forward of the camerostome of a pair of chitinous protuberances called cheeks. They lie along the sides of the mouth organs (figure 3). The mouth organs themselves are laid away in a trough shaped inclination of chitinous covers running from the anterior edge of the camerostome to the rostrum (figures 3 and 4). In the majority of species they have the form of low compact lamellar protuberances with a striated surface. In the species O. nereensis they are not compact but consist of a number of dactylate protuberances (figure 5).

Among live ticks with compact cheeks, I was able to see examples in which the cheeks had their free edges put together. Thanks to this, the mouth organs were completely covered if viewed from the ventral side of the body. Apparently, such a position of the cheeks has a protective significance for the mouth organs while the ticks are moving along a loose substrate in narrow clefts.

In other cases I observed a completely different arrangement of the capitulum and cheeks on a tick. The capitulum stood perpendicular in relation to the ventral surface of the body, which apparently takes place when they are sucking blood from the host; the cheeks appeared to be folded together and laying

forward of the ventrically lowered capitulum; since the cheeks are immobile and not pliable in a front-to-rear direction, then connected together they form a stable, supporting stand. Due to the presence of this stand the capitulum is stably secured in a perpendicular position which is necessary for the insertion of the chelicera and hypostome into the thickness of the host's covering and for the subsequent process of sucking blood. But such a position is efficient for compact cheeks; dactylate cheeks, forming a fringe all together, have a different functional significance.

During a sharp projection of the complex of mouth organs, including the basis capituli, in O. tartakovskyi the mouth organs stand perpendicular to the ventral surface of the tick's body (figure 6).

The idea is being suggested concerning a correlative bond between the cheeks on each side of the mouth organs and the presence of a "crest", made from the folds of the ventral chitinous covers, formed by an anomarginal furrow and pleats with two postnasal folds running into it transversely.

Other coincidences should also be noted. Species of Ornithodoros with cheeks and with a "crest" of folds (O. papillyses, O. verrucosus, O. noreensis, O. tartakovskyi, etc.) are carriers of spirochaetes of tick recurrence; the species O. lahorensis and O. canestrinii are devoid of cheeks, do not have a crest of ventral folds of chitinous covers, and are not carriers of spirochaetes. These considerations speak with regard to species of the Ornithodoros fauna of the USSR.

[Following is the English summary which appears with the Russian article.]

Mechanism of the motion of coxa, trochanter and intercalar articulation and some joint muscles of the legs (ticks of the genus Ornithodoros) is defined. The description of two functions of the cheeks of ticks (protective and supporting) in connection with gnathosoma is given.

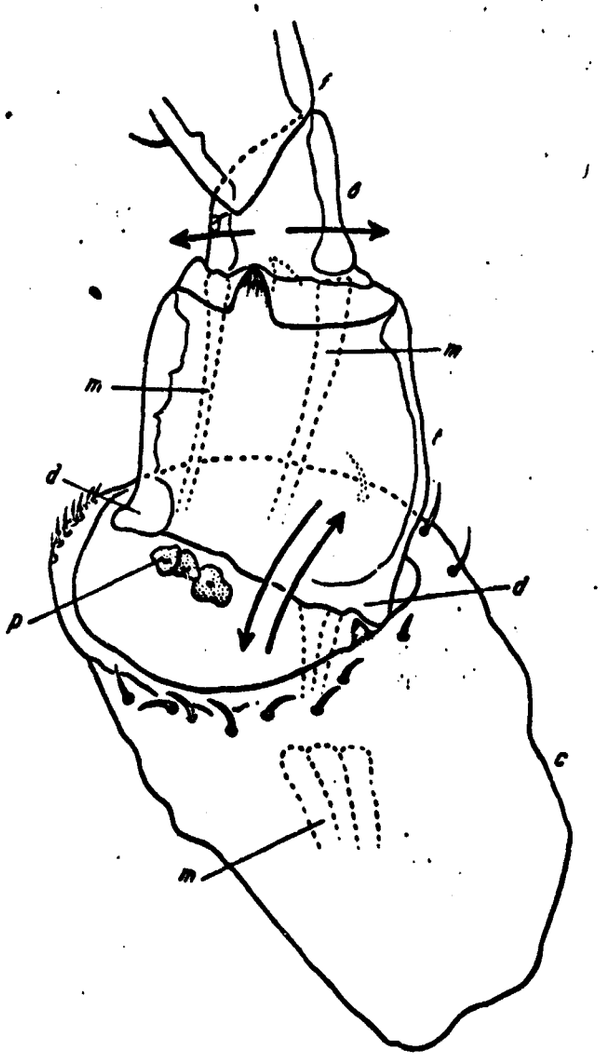

Figure 1. Ornithodoros canestrinii. Base of leg, pair III. Orig.

c - coxa; t - trochanter; b - intercalary segment; f - femur; p - moderating chitinous calyces; d - spurs on base of trochanter, on the right the spur is pushed against the analogous spur of the distal periphery of the coxa, the spur opposite to it is not seen; m - muscles, the arrows show the direction of tilt of the trochanter; the upper pair of arrows show the direction of swing of the intercalary segment in relation to the distal end of the trochanter.

Figure 2. Ornithodoros canestrinii. Base of leg, pair III (blown up drawing). Orig.

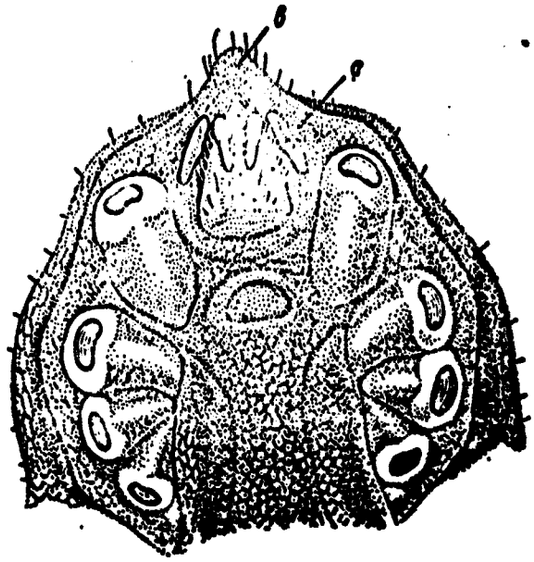

Figure 3. Ornithodoros verrucosus. Front half of the body from the ventral side. Orig.

a - combined cheek on the side of the mouth organs; b - rostrum.

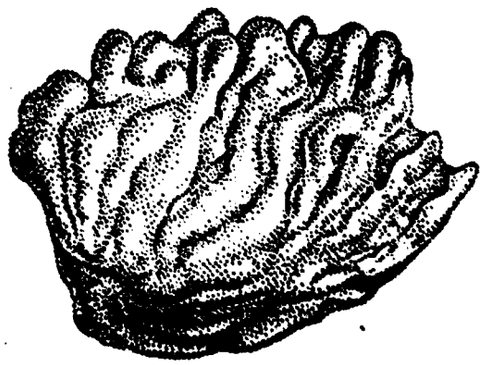

Figure 4. Ornithodoros tartakovskyi. Cheek from the side. Orig.

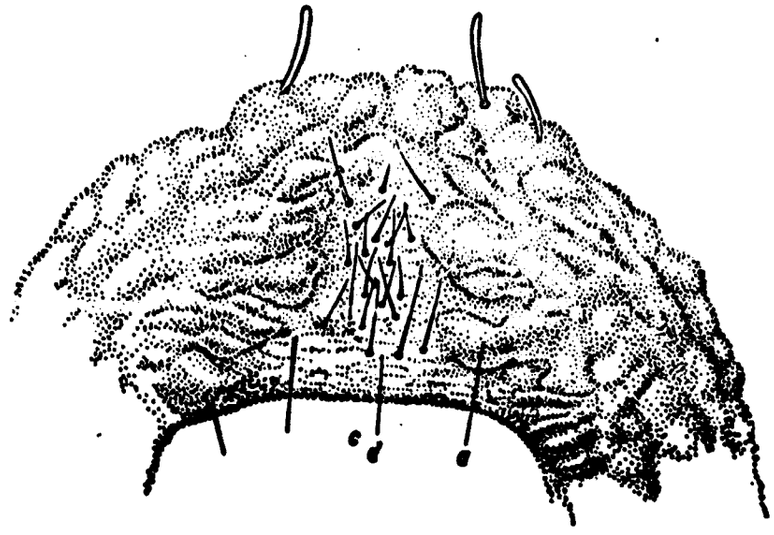

Figure 5. Ornithodoros nereensis. Anterior end of the body from the under side. Orig.

c - anterior section of the camerostome; a - small lobe of dactylate cheeks; d - trough shaped sector between the cheeks under which the mouth organs are located (not depicted on drawing).

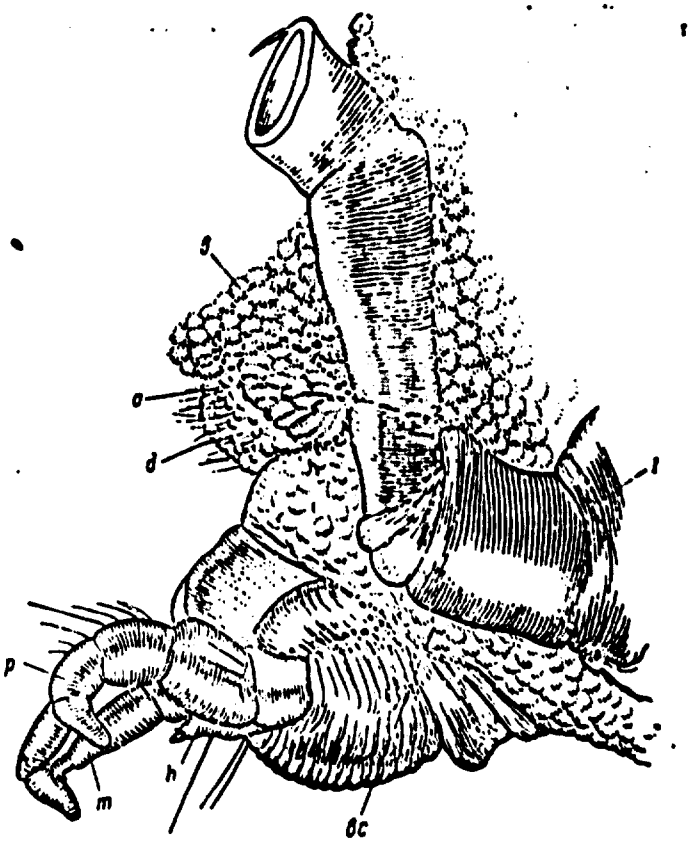

Figure 6. Anterior end of Ornithodoros tartakovskyi from the side. The mouth organs have been fully protruded and stand perpendicular to the plane of the body. Orig.

a - cheek; b - rostrum; p - palpa; m - chelicera; h - hypostome (its lamina is truncated); bc - basis capituli; d - protruding mantles of the trough between the cheeks; I - first pair of legs.